

REMARKS

In the Final Office Action dated March 17, 2000, the Examiner found that claims 8, 33, 34, and 50, which are directed to a seed layer having a size range of less than about 250 angstroms, are allowable over the art of record. With respect to the remaining claims, the Examiner made the following rejections:

Item 1 - Claims 47-48 were withdrawn from consideration as being drawn to a non-elected invention.

Item 2 - Claims 1-46 and 49-69 were rejected under 35 U.S.C. 112, first paragraph, as containing subject matter that was not described in the specification. More particularly, the Examiner objected to the use of the terms "microelectronic" or "micro-sized metal structures on a microelectronic workpiece". Additionally, the Examiner indicated that the term "damascene" as set forth in new claimed 63 appeared to be a new term.

Item 3 - Claims 1-3, 7, 49, 53, 59 and 64, 67-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Farooq et al.

Item 4 - Claims 16-17 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Durbin et al. and further in view of Farooq et al.

Item 5 - Claims 51-52, 54-58, 60-62, and 66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al. and further in view of Gilton et al. Claims 65 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Farooq et al. and further in view of Gilton et al.

Item 6 - Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Farooq et al.

Item 7 - Claims 4-5, 9-10, 12 and 14 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Farooq et al. and further in view of Gilton et al.

Item 8 - Claims 30-32, 35-40, 42 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Farooq et al. and further in view of Gilton et al.

Item 9 - Claims 18-23 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dubin et al. and further in view of Gilton et al.

Item 10 - Claims 24-26 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Dubin et al. in view of Gilton et al. and further in view of Makkaev et al.



Item 11 - Claims 9,11 and 13 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Farooq et al and further in view of Makkaev et al.

The foregoing items were discussed with Examiners Nicolas and Gorgos during a personal interview held on Aug. 29, 2000. The Examiners' courtesy and consideration in granting and conducting that interview are greatly appreciated.

With respect to Item 1, Applicant has canceled claims 47-48.

With respect to Item 2, Applicant's representative, Bob Polit, indicated during the interview that the terms "microelectronic" and "micro-sized metal structures on a microelectronic workpiece" were supported in the specification. For example, the nature of the structures shown in Figures 2A through 2F are described at p. 9, lines 12 et seq in the following manner:

"A cross-sectional view of a micro-structure, such as trench 5, that is to be filled with copper metallization is illustrated in Fig. 2A."

Additionally, throughout the specification, various dimensions are given in terms of Angstroms, a very small unit of length. Still further, it was discussed at the interview that the specific process described in Figures 2A through 2F in connection with one embodiment of the invention is known as a "damascene" process. Accordingly, Applicant respectfully request withdrawal of all of the rejections under 35 U.S.C. 112, first paragraph.

During the interview, the substance of Items 3-11 was also discussed. Applicant's representative noted that the proposed amended claims, now set forth above, distinguish over the prior art of record. More particularly, it was noted that the amended claims now clarify the fact that the initial seed layer is unsuitable for bulk deposition of the metal. One example of how such a seed layer can be unsuitable for bulk deposition of the metal is described in connection



with Figure 1. Specifically, the specification describes such initial seed layer problems in the context of an ultra-thin seed layer and states the following:

"The use of an ultra-thin seed layer 15 generally introduces its own set of problems. One of the most significant of these problems is the fact that such ultra-thin layers do not generally coat the barrier layer 10 in a uniform manner. Rather, voids or non-continuous seed layer regions on the sidewalls, such as at 20, are often present in an ultra-thin seed layer 15 thereby resulting in the inability to properly apply a subsequent electrochemically deposited copper layer in the regions 20. Further, ultra-thin seed layers tend to include spikes, such as at 21, that impact the uniformity of the subsequent electrolytically deposited metal layer. Such spikes 21 result in high potential regions at which the copper deposits at a higher rate than at other, more level regions. As such, the seed layer 15 is not fully suitable for the traditional electroplating techniques typically used after application of a seed layer." (Specification at p. 10, line 16 through p. 11, line 5).

Further, the amended claims clarify the fact that the initial seed layer is subject to repair and bulk deposition operations that are separate and distinct from one another (i.e., repair in an alkaline electrolytic bath/bulk deposition in an acidic electrolytic bath; repair using a first set of deposition parameters/bulk deposition using a different set of processing parameters; repair and bulk deposition steps and apparatus recited using separate claim elements; etc.). The term "enhanced" has been replaced throughout the claims for the term "repair" since the term "repair" implies deficiencies in the initial seed layer and is thus more descriptive of the specific process step. Further, this substitution and terms assists in distinguishing the repair process operation from the bulk deposition operation.

It was noted during the interview that none of the references of record either disclose or suggest that an initial seed layer may be applied that is generally unsuitable for bulk deposition of the metal. Nor do any of the references recognize any deficiencies in the initial seed layers that they described. Further, it was noted that none of the references of record either disclose or suggest that such an initial seed layer may be repaired using an electrochemical process to render



it suitable for subsequent bulk deposition of the metal. Accordingly, Applicant submits that the claims as amended are patentable over the art of record, taken alone or in combination.

For the foregoing reasons, Applicant respectfully requests allowance of the claims of the application and issuance of a patent thereon. If the Examiner finds that the foregoing amendments do not fully address all of the Examiner's concerns, he is encouraged to contact Applicant's representative, Bob Polit, at the telephone number identified below.

Respectfully submitted,

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Robert B. Polit
Reg. No. 33,993
Attorney for Applicant

ROCKEY, MILNAMOW & KATZ, LTD.
180 North Stetson, Suite 4700
Chicago, IL 60601
(312) 616-5400